FH915

User Manual

Version 1.2
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PREFACE

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Regulatory Information

The following sections provide information on this product's compliance with government regulations

FCC Class B Compliance

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate

radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause interference to radio or television equipment reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by on or more of the following measures:

- Reorient or relocate the receiving antenna.
- Move the equipment away from the receiver.
- Plug the equipment into an outlet on a circuit different from that to which the receiver is powered.
- Consult the dealer or an experienced radio/television technician for additional suggestions.

CAUTION: *Any changes or modifications to the equipment not expressly approved by the party responsible for compliance could void your authority to operate such equipment.*

Canadian Emissions Labeling Requirements

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Réglement sur le matériel brouilleur du Canada.

WEEE Directive

The following information is for EU-member states only:

The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the

environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more detailed information about the take-back and recycling of this product, please contact your supplier where you purchased the product or consult.

Technical Assistance

If you have a problem and cannot find the information you need in the product documentation, contact your local dealer. Alternatively, request technical support using the ArWest Communications World Wide Web site at: www.arwestcom.com

Return Material Authorization

Initially, the customer contacts support to report a problem. Please refer to support: support@arwestcom.com

If support determines the problem cannot be resolved over e-mail/Internet, it will authorize the return of the unit for repair or replacement, depending on the nature of the problem.

PRODUCT FEATURES

1.1. Introduction

FH915 radio transceiver is designed as universal license-free modem. It uses 902-928 MHz ISM (industrial, scientific and medical) license free USA/Australia band frequency hopping transmission techniques for excellent reliability in noisy plant environments and European CEPT license free 868-870 MHz band, allocated for narrow band telemetry, alarms and data transfer applications.

Thanks to its small size, and multiple functions, the FH915 is specifically well suited for amount of applications within industrial complexes, for various indoor as well as medium-range applications.

The unmatched features of FH915 include data scrambling, frequency hopping, user selectable transmit output power level, low power consumption sleep modes.

Figure 1-1. FH915

FH915 supports two separate Application Data and Maintenance modes of single UART serial port. The built-in software tools provide the wireless link testing, unit's status and error statistics monitoring. The firmware of the FH915 radio transceiver resides in a flash memory. The updating of the radio transceiver programs is entirely software-based. The flash memory is re-programmable through an UART interface.

The FH915 is developed for exacting customer needs and to have pin-to-pin compatibility with OEM radios AW400Tx, AW400Rx, and AW100Tx.

The Spread Spectrum transceiver is also capable of receiving RF signals through a 50 Ohm impedance external antenna port.

The delivered product is a wireless system, which includes:

> • FH915 – Spread Spectrum Radio Transceiver;

- ModemVU – Windows based Unit Configuration and Maintenance Software Application running on a IBM PC compatible computer and connecting to the device over RS-232 interface or USB-to-Serial adapter.

The setting can be done through the built-in Command Line interface (CLI), or through the configuration and maintenance application software running on PC – ModemVU.

The diagnostic feature of the FH915 system provides the information to monitor and maintain user's communications link. The output transmit power, receive signal strength (RSSI), antenna/feedline condition, and data decode performance are transmitted online without application interruption. The product is designed for maximum performance and reliability even in the harshest environments. Plug and play at its best, robust, withstanding the most adverse of conditions.

1.2. Operating at Spread Spectrum Band

The Spread Spectrum (SSR) technique in which a signal is transmitted on a bandwidth considerably larger than the frequency content of the original information.

Spread-spectrum telecommunications is a signal structuring technique that employs direct sequence, frequency hopping or a hybrid of these, which can be used for multiple access and/or multiple functions.

This technique decreases the potential interference to other receivers while achieving privacy. Spread spectrum generally makes use of a sequential noise-like signal structure to spread the normally narrowband information signal over a relatively wideband (radio) band of frequencies. The receiver correlates the received signals to retrieve the original information signal.

1.3. Modulation Technique

FH915 radio transceiver uses two bands: 902-928 MHz ISM license free USA band and European CEPT license free 868-870 MHz band. In 902-928 MHz band FH915 radio uses frequency hopping transmission techniques. The design is based on high-level modulation techniques which include:

Modulation	902.0-928.0
GMSK – Minimal Shift Keying with Gaussian Filtering	64.0 kbps, 128 *200.0 kHz

The following are its key benefits:

- Ten optimized Frequency Hopping Patterns provides simultaneous operating of several units with minimum of mutual interference.
- FEC coding scheme used with GMSK modulation is based on Convolutional code and the Viterbi decoding algorithm which is the most resource-consuming, but it does Maximum likelihood decoding.

In 868-870 MHz band the design is based on high-level modulation techniques which include

Modulation/ Channel Spacing	12.5 kHz	25 kHz
GMSK – Minimal Shift Keying with Gaussian Filtering	4.8 kbps	9.6 kbps

The following are its key benefits:

- FEC coding scheme used with GMSK modulation is based on Convolutional code and the Viterbi decoding algorithm.
- Powerful FEC scheme used with ArWest proprietary frame format improves the tolerance to interference and ensures the highest link quality at distances range higher than 8 miles (13 km) and roaming speeds of up to 60 mph (96 km/h).

1.3.1. Management Tools

The built-in management tools along with ModemVU (configuration and monitoring software application) will provide the following benefits:

1. Easy user's interface for system configuration and monitoring using well developed CLI .
2. An ability to monitor status, alarms and radio performance through the CLI.
3. Software upgrades and improvements can be downloaded from ModemVU to the units connected with PC/PDA.

1.3.2. Security

The system provides wireless media access protection as well as data scrambling. The following are its key features and benefits:

Product Features
Modulation Technique
Security

1. The Key Sequence generated by Pseudo-random generator scrambles the fully formatted frame (including Frame's CRC). This provides the wireless media access protection.
2. User selectable Frequency Hopping Pattern provides another level of the wireless media access protection.

At the same time it allows operators to increase the number of links deployed in the same location.

GENERAL DESCRIPTION

2.1. Physical Interfaces

2.1.1. Serial Data Interface

The serial asynchronous interface allows connection to external serial devices. It is shared between user data and unit's command/status information. All commonly supported baud rates, parity and bit configurations are available up to 115.2 kbps.

2.1.2. Power Interface

The power interface allows connection to an unregulated DC power source. The DC power source (third-party or user supplied) must provide DC power of 4.0V±5% DC.

The standalone unit's RF interface is a 50-ohm impedance matched standard MMCX connector as required by regulation.

2.1.3. Power Consumption

Power consumption of the Spread Spectrum radio modem at continuous transmission mode with 1W output power level is less than 4500mW (refer to Table 2-1 for details).

Table 2-1. Power Consumption

Operating Mode / Description	Consumption
Maximum for continuous transmission with 1W output power level[1]	< 4500 mW
Maximum for Rx Full Operation Mode	< 2000 mW
Average for Operation Mode with 30% Transmission duty cycle	< 2000 mW
Average for Operation Mode with 50% Transmission duty cycle	< 3000 mW
Sleep Mode	300 mW
Standby Mode, ordered by SLEEP input pin	500 μW

1. The supply voltage (pins 15 and 16 in user interface connector,) must be 3.6 to 4.2VDC to provide RF output power >500mW (licensed operation mode).

2.1.4. Antennas

Antenna type depends on the site requirements, and may be directional or omni-directional. Note that to support 8 miles distance range between Base station and FH915 unit, an antenna mast should elevate the base antenna a minimum of 20 feet above the average level of the terrain.

CONNECTION

3.1. FH915 connection

The FH915 connected directly to Evaluation Kit (p/n 99-571010-01) by its 16-Lead Header Connector, ECS Corp., as it shown on the Figure 2-1.

Adapter   **OEM Board**

to Power Supply

6-20 V DC, 1A   **to Antenna**
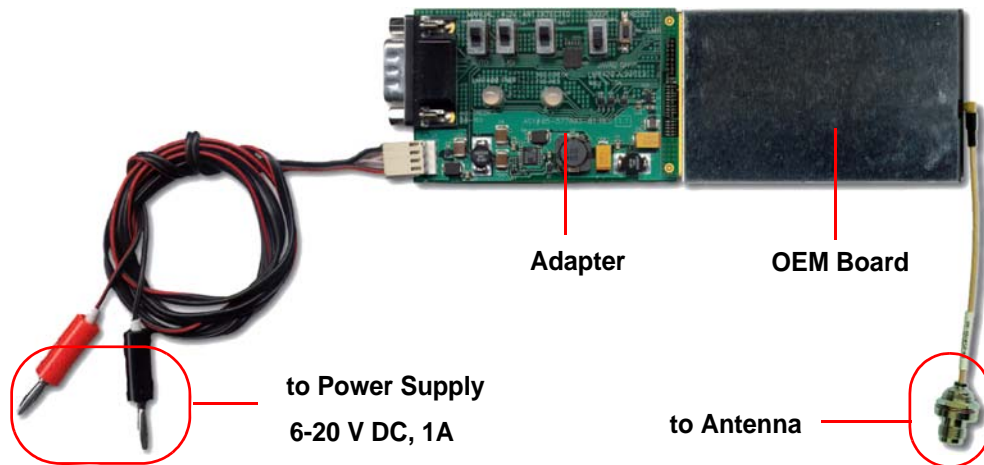
Figure 3-1. FH915 connected to Evaluation Kit

3.2. Antenna connection

The FH915 may be connected to external antenna using TNC to MMCX RA Antenna cable (included in the Kit):

+
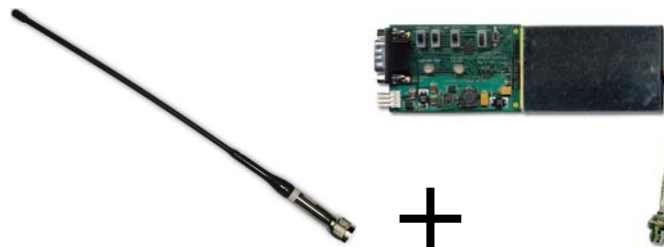
Figure 3-2. Antenna Connection

3.3. Power connection

The FH915 powered through Evaluation Kit and Power Cable (included in Kit). The Banana plugs of power cable may be connected to any available laboratory power supply, battery or other power source with power parameters, suitable for particular FH915 power specifications.

CAUTION: *Evaluation Kit does not provide any over-voltage protection. Connecting Evaluation Kit to voltage exceeding particular FH915 power voltage range may cause damage of FH915 and Evaluation Kit board.*

CAUTION: *Evaluation Kit provides reverse polarity protection only in voltages range, specified for particular FH915.*

3.4. Serial RS-232 connection

A standard Null-Modem cable (included in Kit) with DB-9 Female connectors on both ends may be used to connect PC COM_X port with Serial port on adapter.

Adapter's DB-9 male connector external view and pinout is shown on the Figure 3-3.
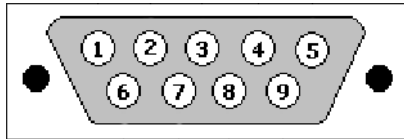
Figure 3-3. DB-9 Male connector

Table 3-1. DB-9 Male Connector Specification

Pin	Signal Name	Dir	Description
1	-	-	Not used
2	RXD	I	Receive Data
3	TXD	O	Transmit Data
4	DTR	O	Data Terminal Ready
5	GND	-	Signal Ground
6	DSR	I	Data Set Ready
7	RTS	O	Request To Send
8	CTS	I	Clear To Send
9	-	-	Not used

Please, refer to particular external device Serial port specification to select and use right Serial cable for proper connection.

COMMAND LINE INTERFACE

The built-in user-friendly Command Line Interface (CLI) allows user to perform a full configuration of the unit and read the statistics and alarm status. It is the most powerful tool to configure the unit. It makes changes to all possible settings that system will not be able to determine automatically.

The CLI commands allow user to configure and reconfigure the unit's settings. The user configuration parameters that could be changed through the CLI are:

- Data Port Settings
  - Baud Rate
  - Data Bits (8, 7)
  - Stop Bits (1,2)
  - Parity (Odd, Even, None)
  - Flow control (None or RTS/CTS)
- Radio Operation Modes

Note: The unit's configuration that is set or modified through the CLI will be lost after unit's reboot, unless the saving operation is used to store a new setting in the unit's configuration file.

The CLI commands also provide filing operations, which include:

- Downloading Software Images
- Saving into the configuration files the configuration parameters modified through the CLI.

4.1. Command Line Interface Convention

The following convention is implemented in FH915 Command Line Interface (CLI):

- The Carriage Return/Line Feed (CR/LF, 0x0D/0x0A) is a command delimiter. Command delimiters CR or LF or CR+LF are valid. Preferable delimiter - LF.
- The Carriage Return/Line Feed (CR/LF, 0x0D/0x0A) is a reply delimiter followed by the "CLI>" prompt if Echo option is On.
- The Carriage Return/Line Feed (CR/LF, 0x0D/0x0A) is a reply delimiter if Echo option is Off (default option).
- The 2-digit number followed by "@" in the unit's reply indicates the error code (refer to Table 4-1 for description), if Echo Off is selected.
- A successfully performed command is replied by @00 code, if Echo Off is selected.

- A command with the certain [*Parameter Name*] and blank [*Parameter List*] displays the current settings for a given parameter.
- To set the mode ordered by CLI commands as permanent User Setting (the setting automatically selected for the boot-up unit) the SAVE command must be asserted.
- [/?] orders to show the help information for the given command.
- Commands are not key sensitive; small, none capital characters can be used to enter CLI commands.

Table 4-1. Command Line Interface Error Codes

Error Code	Short Description
0x01	Command Syntax Error.
0x02	The parameter has a format error.
0x03	The parameter is out of allowed range.
0x04	The command is not valid for specific radio model.
0x05	Unspecified Error

4.1.1. Software Switching to Maintenance Mode

To switch to Maintenance mode the special byte-sequences with special meanings are used:

- Escape-Sequence: "+++" with 20 ms guard time before and after the command characters
- Escape-Acknowledge: "@00<CR><LF>".

Happy Flow

1. In data-mode the unit starts looking for the Escape-sequence if there is no data from DTE for more than 20 ms (Start Guard Time).
2. If the unit detects the Escape-Sequence:
- The transmitter continues sending over the air the data received from DTE before Escape-Sequence;
- The Receiver immediately stops forwarding to DTE the data received over the air and buffers it instead.
3. The radio unit waits for 20 ms and then sends Escape-Acknowledge to DTE if there is no data from DTE during 20 ms of Stop Guard Time.
4. The unit goes to Maintenance mode and discards Escape-Sequence from input buffer. The modem is immediately ready to receive commands. At the same time it continues buffering the data received over the air since step 2.

Escape-Sequence in Data

During its waiting in step 3, the unit receives data from DTE:

- The unit sends buffered Escape-Sequence from DTE to the air;

- The unit sends all buffered data received from the air since step 2 to DTE and stays in data-mode (i.e. transmits data received from DTE over the air – including the just received, unexpected, data and forwards data received over the air to DTE.)

4.1.2. Switching to Data Mode

- DTE sends the CLI command "DATAMODE<CR>" or „DATAMODE<LF>" to the unit.

Note: Command "DATAMODE<CR><LF>"will be accepted as command "DATAMODE<CR>" and Data Byte=0x0A.

- The data received over the air goes from buffer to DTE. If you need clear the buffer before going to datamode use the CLI command "DATAMOD<LF>".
- Unit immediately goes to datamode, so that the DTE can start sending data.
- If no valid CLI commands received from DTE within 1 minute, the unit will automatically switch back to data-mode.

Note: The data received over the air could be lost due to Rx buffer overflow if the unit stays in Maintenance mode long time.

4.2. Commands

4.2.1. LINK

The LINK command is responsible for configuring radio's operation mode.

LINK [*Parameter Name*] [*Parameters List*] [*/?*]

LINK commands are as common so specific for two bands: 902-928 MHz band and 868-870 MHz band:

Parameter Name	Parameter List
FEC	0 – Disable Forward Error Correction (a default setting) 1 – Enable Forward Error Correction
FHOP	(0-9) - Frequency Hoping Pattern numbers for USA; (10-19) - Frequency Hoping Pattern numbers for Australia; For EU parameter FHOP not applied
MOD	5 - GMSK
PWRB	(15 – 30) – RF output Power in dBm
SCRAM	0 – No Scrambling 1 - Scrambling with Pseudo-Random Sequence Generator (a default setting) 2 - Scrambling with User defined SEED.
SCR	001,...,511 - User defined decimal SEED
SPACE	0 - 25.0 kHz Channel Spacing (a default setting) 1 - 12.5 kHz Channel Spacing 2 - 6.25 kHz Channel Spacing

Parameter Name	Parameter List
PMP	0 – "Any transmits, any receives". At the receiver side neither the source nor the recipient is validated. If parameter PMP =0, then its value is not displayed in a "link\n" response. (a default setting) 1 – "Any transmits to me only". The receiver compares the received code DST with its code SRC. If the received code DST coincides with the code SRC of the receiver, the received data are distributed to the port. If the received code DST is not coincide with the code SRC of the receiver, the received data to the port are not provided. 2 – "Certified Base transmits to any". The receiver compares the received code SRC and code KNW. If the received code SRC coincides with the code KNW, stored in the configuration file of the receiver, the received data are distributed to the port. If the received code SRC is not coincide with the code KNW, then the received data to the port are not provided. 3 – "Certified Base transmits to me only". The receiver compares the received codes: code DST with its code SRC and the code SRC with the code KNW. If these codes match the received data are distributed to the port.
REP	0 – Repeater mode is disabled. If parameter REP =0, then its value is not displayed in a "link\n" response. (a default setting) 1 - Repeater mode is enabled. Modem retransmits the received data.

The LINK command without Parameter Name indicates all values.

4.2.2. MAP F

The MAP F command prints the initial frequency of the receiver: 915000000

4.2.3. MAP FTX

The MAP FTX command prints the initial frequency of the transmitter: 915000000

4.2.4. MAP Fddddddddd

The MAP Fddddddddd command sets the initial frequency of the receiver.

For example: ddddddddd = 912000000 sets the initial frequency 912000000 Hz.

4.2.5. MAP FTX ddddddddd

The MAP FTX ddddddddd command sets the initial frequency of the receiver.

For example: ddddddddd = 924000000 sets the initial frequency 924000000 Hz.

4.2.6. RGN

The RGN command is also responsible for configuring radio's operation mode.

RGN [*Parameters List*]

Parameter List	Short Description
0	Sets EUR region
1	Sets USA region (a default setting)
2	Sets AUS region

The RGN command without parameter prints the Region number.

4.2.7. TRFC

The TRFC command is also responsible for configuring radio's operation mode.

TRFC [*Parameters List*]

Parameter List	Short Description
0	0 – Disable Packet repeating
1	1 – Enable Packet repeating (a default setting)
2	2 - Transparent mode

If the TRFC=1 each Data Packet is transmitted twice: first time on the current time and frequency, second time on the next time and frequency position.

If TRFC=2 ("Transparent mode" On) two modems implement a "full duplex" - duplex transmission mode in which data transfer maintained "simultaneously" with the reception of data.

4.2.8. LSRT

The LSRT command is specific for USA and AUS region. It changes Link Simbol Rate.

LSRT [*Parameters List*]

Parameter List	Short Description
0	64000 kHz (a default setting)
1	32000 kHz
2	16000 kHz
3	8000 kHz

The LSRT command without Parameter prints Link Symbol Rate parameter.

4.2.9. DCRC

The DCRC ("Data CRC") command is manage the output of the received data to the port.

DCRC [*Parameters List*]

Parameter List	Short Description
0	0 - received data are distributed to the port, regardless of the received data CRC. (a default setting)
1	1 - data are distributed to the port only if the CRC is correct.

The DCRC command without Parameter prints DCRC parameter.

4.2.10. DLNG

The DLNG ("Data Subpackage Length") command enables the validation of the receipted parameter - length of subpackage.

DLNG [*Parameters List*]

Parameter List	Short Description
0	0 - validation of the receipted parameter length subpackage is not used. (a default setting)
1	1 - validation of the parameter is used

The DLNG command without parameter prints DLNG parameter.

4.2.11. DSRV

The DSRV ("Data Service") command allows the transmitter to control the tuning of the receiver. When DSRV = 1 the receiver settings - FEC, SCRAM, TRFC - transmitted from the transmitter to the receiver through the air.

DSRV [*Parameters List*]

Parameter List	Short Description
0	0 - the receiver's parameters are set from the configuration file. (a default setting)
1	1 – FEC, SCRAM, TRFC are set from service data passed to the receiver through the air.

The DSRV command without parameter prints DSRV parameter.

4.2.12. LBT

The LBT ("Listen Before Talk") command allows to verify the channel occupancy before subpackage transmitting. If the channel was occupied at the previous slot, the current slot is not used for data transmission.

LBT [*Parameters List*]

Parameter List	Short Description
0	0 - Listen Before Talk mode is turned off.
1	1 - Listen Before Talk mode is enabled. (a default setting)

The LBT command without parameter prints LBT parameter.

4.2.13. WHT

The WHT command defines type of data.

WHT [*Parameters List*]

Parameter List	Short Description
43	43 - The receiver sees the received data as Command.
44	44 - The receiver sees the received data as Data. (a default setting)

The WHT command without parameter prints WHT parameter.

4.2.14. SRC

The SRC command defines "address" of data (the data source code). By defaults SRC coincides with the last three symbols of the transmitter SN, but can be reprogrammed.

SRC [*Parameters List*]

Parameter List	Short Description
XXX	XXX - the data source code (three hex symbols).

The SRC command without parameter prints SRC code.

4.2.15. DST

The DST command defines destination "address" of data. Destination address corresponding to the source code of the recipient.

DST [*Parameters List*]

Parameter List	Short Description
XXX	XXX - the data destination code (three hex symbols).

The DST command without parameter prints DST code.

4.2.16. KNW

The KNW command defines the code of the certified data source.

KNW [*Parameters List*]

Parameter List	Short Description
XXX	XXX - the certified data source (three hex symbols).

The KNW command without parameter prints KNW code.

4.3. Serial Interfacing Commands

4.3.1. PORT

The PORT is an object that responsible for data port interface configurations like Bit Rate, Flow Control, etc.

DPORT [*Parameter Name*] [*Parameters List*] [*/?*]

Parameter Name	Parameter List
RATE	4 – 9600 baud 5 – 14400 baud 6 – 19200 baud 7 – 38400 baud 8 – 57600 baud 9 – 115200 baud, a default setting
BITS	Set number of bits in one byte (8 or 7) 8 is a default setting
STOP	1 - One Stop bit 2 - Two Stop bits
PARITY	0 – None, a default setting 1 – Odd 2 – Even
FLOW	0 – None 1 – Not used 2 - HW (RTS/CTS), a default setting

4.4. Special Commands

4.4.1. BOOT

The BOOT command is intended to reboot the unit.

4.4.2. HELP

The HELP command types the list of all available commands:

```
Popular Commands
      BOOT- Reboot the unit
```

```
          INFO- Product ID along with Hardware/Software Versions
          STATE- Transceiver Status
          SAVE- Save Current Configuration into Configuration File

          +++   - (without <CR>) - Exit Data Mode
          DATAMODE - Exit Command Mode

          LINK  - Print RF Link Operation Mode
          XMOD IMAGE - Activate X-Modem Protocol to load Firmware

          TSTSGL /?  - Displays Test Signals particularity

               See Manual for details
    @00
```

4.4.3. SAVE

The SAVE command is intended to store the unit's currently used configuration into the User Configuration file. The configuration stored in the User Configuration file is activated by automatically after unit's reboot.

4.4.4. CFG2DFLT

The CFG2DFLT command cleans current Configuration. After BOOT command all configuration parameters will be default.

4.4.5. XMOD IMAGE

The XMOD IMAGE command in Maintains Mode activates X-modem protocol to download the Modem part of the Firmware Image.

Use this command with one delimiter: "XMOD IMAGE<CR>" or Command "XMOD IMAGE<LF>".

 Note: Command "XMOD IMAGE<CR><LF>" will be accepted as command "XMOD IMAGE<CR>" and
          byte of Firmware Image 0x0A.

4.5. Identification and Diagnostics Commands

4.5.1. INFO

The INFO command is used to retrieve the FH915 Radio ID along with its Hardware version, the loaded real- time software version/revision and BootLoader's version.

INFO [*Parameter Name*] [*/?*]

Parameter Name	Short Description
ID	Product ID
SN	Serial Number (SN)
HW	3 – hardware revision
FW	2.2.30 - firmware version
BL	4.03 - BootLoader Version

The INFO command without Parameter Name indicates all values:

```
FH915 Land Mobile Radio, Javad GNSS.
Product ID =41
S/N =30196
Hardware =3
Firmware =2.2.32
BootLoader =4.03
```

4.5.2. STATE

The STATE command is used to check the state of the wireless link.

STATE [*Parameter Name*][*/?*]

Parameter Name	Short Description
Region	0-EU; 1-USA; 2-Australia
Tx	Displays the initial frequency of the transmitter
Rx	Displays the initial frequency of the receiver
T	-30°C to 100°C – Displays the temperature inside of enclosure

The STATE command without Parameter Name indicates all values:
```
Region =1
Tx =915000000
Rx =915000000
T=46.00
```

4.5.3. IC

The IC command prints string:

```
IC: 3504A-FH915
@00
```

4.5.4. FCC ID

The FCC ID command prints string:

```
FCC ID: WJ4FH915
@00
```

4.5.5. GTX

The GTX command allows get from port the Number of transmitted bytes.

GTX [*Parameters List*]

Parameter List	Short Description
0	0 – Disable send to port the Number of the transmitted bytes (a default setting).
1	1 – Enable send to port the Number of the transmitted bytes.

4.5.6. RSS

The RSS command send to port the string: 00 0031 -85.7

Where: 0031 - the received Packets Number;

      00   - the received Packets Number with bad Checksum;

      -85.7   - RSSI (dBm) calculated along the last Packet;

After reading both the received Packets Number and the received Packets Number with bad Checksum are cleaned.

4.5.7. RSSI

The RSSI command send to port RSSI (dBm) calculated along the last Packet.

4.5.8. RSSM

Modem stores the last RSSI values for each particular frequency on which a subpackage was received. An array of the last RSSI for 128 possible frequencies can be read by command "rssm\n".

4.5.9. RSSC

The command RSSC clears particular RSSI values obtained by using the command RSSM to default value -140.7 dBm.

4.5.10. RNSS

The command RNSS prints last Noise Strength measured between Data Sabpackages.

4.5.11. NSCN

The command NSCN allows to get the power of noise and interference for 128 frequencies from 902200000 to 927600000.

NSCN [*Parameters List*]

Parameter List	Short Description
d	d – threshold, dB

4.5.12. SCAN

The command SCAN allows to get the power of noise and interference for defined range of frequency with defined step.

SCAN [*Parameters List*]

Parameter List	Short Description
dddddddddd DDDDDDDDD sssss	dddddddddd – Begin frequency, Hz DDDDDDDDD – End frequency, Hz sssss – step, Hz

4.5.13. SCNS

The command SCNS stop scanning.

4.6. Modem protection from interference

If interference contains a big power at some frequency such frequency ("unwanted frequency") can be excluded from the use. To eliminate unwanted frequencies they should be placed to list and saved in configuration file.

4.6.1. NLST

The NLST command prints the list of "unwanted frequencies". By default the list is empty.

4.6.2. NADD

The NADD command adds some frequency to the list of "unwanted frequencies". The added value of the frequency is rounded to the nearest used for frequency hopping.

NADD [*Parameters List*]

Parameter List	Short Description
dddddddd	dddddddd – frequency value, Hz

Example: The command "nadd 915666777\n" add to list frequency 915600000 Hz. Its number equal 0x43.
The command "nadd 918111222\n" add to list frequency 918200000 Hz. Its number equal 0x50.

The NLST command prints the list:
```
43 915600000
50 918200000
@00
```

4.6.3. NAPL

The NAPL command applies the list of "unwanted frequencies" and forms the frequency hopping sequence without "unwanted frequencies". The list of "unwanted frequencies" from configuration file will be applied automatically by Reset or Power On of the modem.

To save the list in the configuration file, you must issue the command save\n.

4.6.4. NDEL

The NDEL command deletes frequency from the list of "unwanted frequencies".

NDEL [*Parameters List*]

Parameter List	Short Description
HH	HH – hex frequency number

Example: The command "ndel 43\n" deletes frequency 915600000 Hz from the list.
The "XMOD IMAGE" command in Data Route Mode activates X-modem protocol to download the Data Route part of the Firmware Image.

Command Line Interface

Modem protection from interference
NDEL

TECHNICAL SPECIFICATIONS

FH915 DSP based integrated Spread Spectrum Modem is the single board OEM wireless transceiver intended for SCADA, outdoor telemetry applications and transmission /receiving of differential corrections and additional information by terrestrial radio channels between two GNSS receivers.

The Spread Spectrum module provides half-duplex communication with transmitter output power of 1 W (+30 dBm) in the frequency band 902-928 MHz z. In 868-870 MHz band module provides half-duplex communication with transmitter output power up to 0.5W (+27 dBm) with channel spacing 25.0/12.5 kHz. It supports GMSK modulation method.

A.1. Technical Specifications

A.1.1. Radio Receiver

Table A-1. Radio Transceiver Specifications

Parameter	Details
Frequency Range	902-928 MHz (USA) 915-928 MHz (Australia) 868-870 MHz (EU) with 25/12.5 kHz CS
Link Rate, symbols/second	8000, 16000, 32000, 64000 (USA/Australia) 4800, 9600 (EU)
Carrier Frequency Stability	±1 ppm
Modulation	GMSK
Communication Mode	Half duplex, simplex
Receiver Sensitivity for GMSK (BER 1x 10-4)	-104 dBm for 64 kHz (USA, AUS) -110 dBm for 25 kHz CS (EUR) -112 dBm for 12.5 kHz CS (EUR)
Receiver Dynamic Range	-119 to -10 dBm

A.1.2. Radio Transmitter

Table A-2. Transmitter Specifications

Parameter	Details

Output Power	USA, AUS	15 dBm to 30 dBm in 1 dB steps (32mW to 1W)
	EUR	7 dBm up to 27 dBm in 1 dB steps (5mW to 0.5W)
Output Power Control Accuracy		±1.5 dB (at normal test conditions)
Carrier Frequency Stability		±1.5 ppm initial stability over temp with ±3.0 ppm aging/year
Max. Frequency Error		±1.0 kHz (at normal test conditions)
		±1.5 kHz (under extreme test conditions)

A.1.3. Modem

Figure A-1. Modem Specifications

Component	Details
Interface	DSP UART (serial port)
Interface Connector	16-lead Connector
Data Speed of Serial Interface	9600 - 115200 bps
Data Rate of Radio Interface (USA/Australia)	8000 bps – GMSK 16000 bps –GMSK 32000 bps – GMSK 64000 bps – GMSK
Data Rate Radio Interface (25 kHz CS)	9600 bps – GMSK
Data Rate Radio Interface (12.5 kHz Channel Spacing)	4800 bps – GMSK
Forward Error Correction (FEC)	Convolutional code
Data scrambling	Yes

A.1.4. Compliance

Component	Details
FCC	FCC Part 15.247
ETSI	EN 300 220-1, EN 301 489-1

A.1.5. General

Component	Details
Input Voltage	4.0 V ± 5%
Power Consumption (average)	3 W – transmit with 50% duty cycle (1 W TPO) 1 W – receive mode
Operation Temperature	-40ºC - +60ºC
Storage Temperature	-40ºC - +80ºC
Dimensions	L: 80 mm x W: 46.5 mm x H: 7.6 / 9.5 mm
Weight	43 g

Features

- DSP-Modem
- Zero-IF Technologies
- 902-928 MHz (USA), 915-928 MHz (Australia), 868-870 MHz (EU) Frequency Ranges
- Up to 115200 bps Serial Interface Data Rate
- Embedded Firmware Compensation for Operation at Extremely Low and High Temperatures
- Compact Design

A.1.6. Mechanical Properties For End-product

Dimensions for PCB Mounted Enclosure:

80 mm x W: 46.5 mm x H: 7.6/9.5 mm (3.15" x 1.83" x 0.3")

BOTTOM

[2.95 in]
75.00 mm

[1.83 in]
46.50 mm

[3.15 in]
80.00 mm

[.3 in]
7.6 mm

[.37 in]
9.50 mm

SIDE

Connector, 16-lead,
Thru-hole 2x8, Header,
".050"

DIMENSIONS-mm[inch]
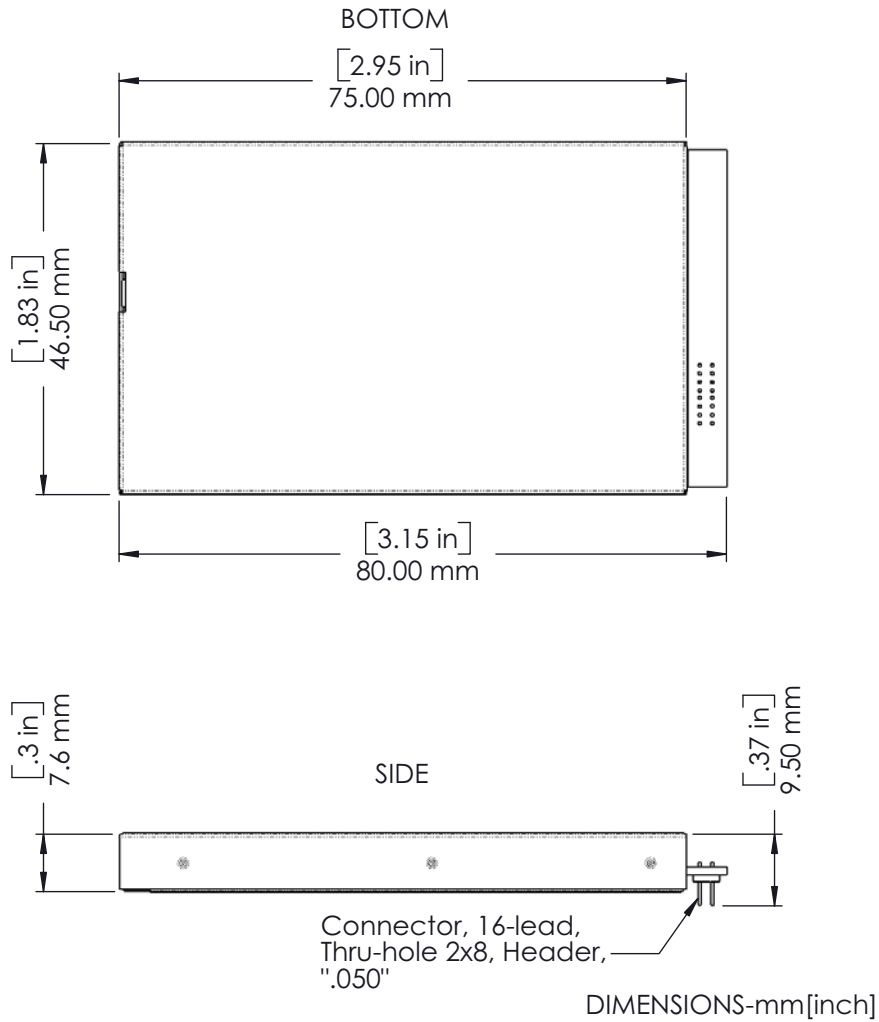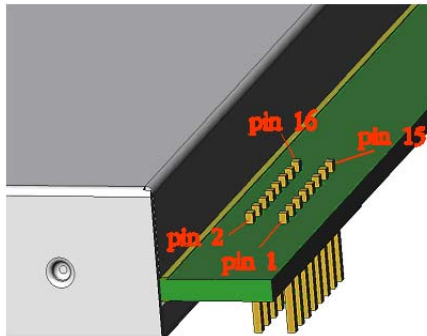
A.2. External Connectors

A.2.1. Antenna Connector

J2 is Antenna Input / Output Connector: MMCX RIGHT ANGLE PCB JACK, AMPHENOL P/N 908-24100

A.2.2. Main Connector

The user ports connector is used to provide connection with an external DTE or with the PC running ModemVU management software applications.

 Note: The RS232-to-TTL adapter must be used to provide physical level compatibility between COM port of PC running ModemVU and FH915 user interface port.

16-Lead Header Connector, ECS Corp. P/N 9616-D1-01-03.

PIN #	Signal Designator	Signal name	Description	I/O	Comments
1	GND	GND	Ground	-	Signal and Chassis Ground
2	DSP UART 1	TXD	Transmit Data	TTL Input	Serial Data Input
3	DSP UART 2	RXD	Receive Data	TTL Output	Output for received serial data
4	DPORT-5	DTR or DP/MP	Data Terminal Ready	TTL Input	Control line can be used as a backup method for entering Command mode: (0V) – Maintenance Mode; (3.3V) – Data Mode An internal 100K pull-up enables Data Mode if this signal is left unconnected. Maintenance Mode is also accessible by transmitting an escape sequence.

PIN #	Signal Designator	Signal name	Description	I/O	Comments
5	DPORT1	CTS	Clear to Send	TTL Output	Used to control transmit flow from the user to the radio: (0V) – Transmit buffer not full, continue transmitting (3.3V) – Transmit buffer full, stop transmitting
6	TTLI1	SLEEP	Sleeps/wakes radio Receive only	TTL Input	In sleep mode, all radio functions are disabled consuming less than 50µA. An internal 10K pull-down wakes up the radio if this signal is left unconnected. At wake up, any user programmed configuration settings are refreshed from flash memory, clearing any temporary settings that may have been set: (3.3V) – Sleep Radio; (0V) – Wake Radio As an option could be used as TTL Input Line 1.
7	DPORT3	MDM_GRN	Data Carrier Detect	TTL Output	Used by remotes to indicate that the remote has successfully acquired the signal from base station: (0V) 1 – Carrier detected (synchronized) (3.3V) 0 – No carrier detected (not synchronized)
8	DPORT4	RTS	Request to Send	TTL Input	Gates the flow of receive data from the radio to the user on or off. An internal 10K pull-down enables data receive if this signal is left unconnected. In normal operation, this signal should be asserted: (0V) – Receive data (RxD) enabled (3.3V) – Receive data (RxD) disabled
9	DPORT2	DSR	Data Set Ready	TTL Output	Used to control transmit flow from the user to the radio: (0V) 1 – Receive buffer has data to transfer; (3.3V) 0 – Receive buffer is empty
10	RES CONT	RESCONT	Reset Control	TTL Input	Reset the radio by shortening this pin to the ground.
11	TTLO1	TTLOUT1	TTL Output Line 1	TTL Output	Reserve line
12	TTLO2	TTLOUT2	TTL Output Line 2	TTL Output	Reserve line
13	GND	GND	Ground	-	Signal and Chassis Ground
14	TTLI2	TTLIN	TTL Input line	TTL Input	An internal 100K pull-up resistor is applied.
15	VCC36	PWR	Power Supply	External	Regulated positive 4.0V DC from ext. Power Supply.
16	VCC36	PWR	Power Supply	External	Regulated positive 4.0V DC from ext. Power Supply.

SPREAD SPECTRUM RADIO USAGE

Many countries require a license for radio users. Be sure you comply with all local laws while operating a Spread Spectrum radio.

The quality and strength of the Spread Spectrum signals translates into range for Spread Spectrum communications.

The system's range will greatly depend on the local conditions. Topography, local communications and even meteorological conditions play a major role in the possible range of communications.

SAFETY WARNINGS

Read these instructions.

- Keep these instructions.
- Heed all warnings.
- Follow all instructions.
- Clean only with a damp cloth.
- Do not block any of the ventilation openings. Install in accordance with the manufacturer's instructions.
- Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
- Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
- Only use attachments/accessories specified by the manufacturer.
- Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, or has been dropped.
- Apparatus shall not be exposed to dripping or splashing and no objects filled with liquids, shall be placed on the apparatus.

C.1. General Warnings

FH915 is a wireless device used in a mobile application, at least 100 cm from any body part of the user or nearby persons.

 Note: Minimum separation distance of 100 cm between the antenna and persons must be maintained.

This product should never be used:

* Without the user thoroughly understanding operator's manual.
* After disabling safety systems or altering the product.
* With unauthorized accessories.
* Contrary to applicable laws, rules, and regulations.

DANGER: THE FH915 SHOULD NEVER BE USED IN DANGEROUS ENVIRONMENTS.

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ArWest Communications Corp., Inc. ("Company") warrants, to the end-user only, that the Narrow Band Radio Modems ("Radios") purchased (a) conforms to the Company's published specifications for the model purchased, and (b) is free from defects in material or workmanship. The duration of this warranty is twelve (12)[1] months from date of purchase and any claim for breach of warranty must be brought to the Company's attention within such twelve (12) month period and the Receiver must be returned for action on any such claim within twelve (12) months from the date of purchase. Within a reasonable period of time after a claim, the Company will correct any failure of the Radio to conform to specifications or any defect in materials or workmanship, or replace the Radio, or, at its option, provide a full refund of the purchase price. A repaired or replaced product is warranted for 90 days from the date of return shipment to the buyer, or for the balance of the original warranty period, whichever is longer. These remedies are the buyer's exclusive remedies for breach of warranty.

To obtain warranty service, the buyer must return the Radio, postage-paid, with proof of the date of original purchase and the buyer's return address to the Company or an authorized service center. The Company will not be responsible for any loss or damage to the product incurred while it is in transit or is being shipped for repair. It is the buyer's responsibility to arrange for insurance, if the buyer so desires.

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1. The warranty against defects in ArWest adapter, antenna, battery, charger, or cable is 90 days.

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JAVAD
ArWest

900 Rock Avenue, San Jose, CA 95131 USA
Tel: + 1(408) 770-1790
Fax: + 1(408) 770-1799
www.arwestcom.com